FLAGGED BRISTLE AND BRUSH MADE FROM SAME

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United States Patent Office

2,812,530
Patented Nov. 12, 1957

2,812,530
FLAGGED BRISTLE AND BRUSH MADE FROM SAME
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Application June 28, 1955, Serial No. 518,484
5 Claims. (Cl. 15—159)

This invention relates to synthetic monofilaments, particularly to synthetic monofilaments in the form of flagged brush bristles, to a method for making such bristles and to a brush made from them.

The best brush bristles have traditionally been hog bristles originating in China. Because of the increasing difficulty in obtaining such bristles, it has been proposed to make synthetic bristle from resinous materials such as nylon (synthetic linear fiber forming polyamides) or polystyrene.

Synthetic bristles of this kind have not, however, been wholly satisfactory. Thus for example, bristles made from known synthetic bristles do not retain as much liquid as do natural bristles, and in general do not leave as smooth a finish. Again, known synthetic bristles when used in cleaning brushes, for example in car wash brushes, tend to scratch painted or polished surfaces.

To overcome these defects it has been proposed to flag the tip of the bristles. Flagging consists in splitting the bristles one or more times for a distance of about one inch from the tip. By flagging, the capacity of the brush to hold paint is increased. Flagging, however, has hitherto only been done successfully with nylon bristles. If it is attempted to flag bristles of polystyrene, for example, they will melt, break, or wear away, depending on the technique used. Even with nylon bristles, flagging is done only with difficulty and the extent of flagging achieved is not high, amounting, for example, to 3 or 4 separate ends from 0.012 inch bristle. Moreover, nylon bristles cannot be flagged after they have been assembled in the brush because the force required to split them is sufficient to destroy a high percentage of the brushes. Nylon bristles must therefore be flagged before assembly into brushes, a procedure which greatly increases the difficulty and the expense of brush making.

According to the present invention, these difficulties are overcome by means of a flagged bristle consisting essentially of at least two essentially incompatible synthetic resins selected from the group consisting of polystyrene, styrene-acrylonitrile copolymers containing about 20% and about 37.5%, preferably between about 27% and about 30%, by weight acrylonitrile, and synthetic linear fiber forming polyamides, one of said resins constituting about 1% and about 99% of the filament by weight.

Preferably, one of said resins constitutes between about 5% and about 95% of the weight of the bristle.

Bristles according to the present invention can be flagged by cold drawing them to the breaking point or by subjecting them to an impact on their surface, as for example by thrusting them into the rotating blades of a fan-like flagging machine without attempting to penetrate the individual filaments. Upon drawing or impact, filaments according to the invention spontaneously feather into a great number of sub-filaments; thus for example, a 0.012 inch filament may split into more than 40 sub-filaments. In this they are distinguished from polyamide or nylon filaments which must be subjected to the action of a sharp tool which will penetrate the individual filaments to split them.

The invention also includes a brush having bristles of the type described.

The polystyrene used in the present invention is readily obtainable on the open market. It may have a molecular weight on the order of about 45,000 to about 70,000.

The styrene-acrylonitrile copolymer suitable for use as an ingredient in the present bristle is described in detail in British Patent 590,247. As described in that patent, it should contain between about 20% and about 37.5% acrylonitrile. Preferably the copolymer will contain between about 27% and about 30% acrylonitrile. The copolymer will usually have a molecular weight on the order of about 60,000 to about 80,000, preferably around 64,000.

The fiber forming synthetic linear polyamides which may be used in the present invention are described in detail in the United States patents to Carothers, Numbers 2,071,250, 2,071,253 and 2,130,948. A preferred polyamide is polyhexamethylene adipamide.

Filaments according to the invention may be prepared by melting the ingredients set forth above and extruding the molten mixture, usually at a temperature between about 200° C. and about 290° C., through an orifice of suitable size to form a monofilament. The filament so obtained is then stretched from about 300% to about 500% at a temperature between about 120° C. and about 160° C., and allowed to cool. Stretching in this manner serves to orient the filament and greatly benefits its flagging properties. Subsequently, the filament may be cut into appropriate lengths and flagged; or cut, mounted in a brush and then flagged.

The invention will be further described with reference to the accompanying drawing in which:

Fig. 1 is a schematic flow diagram illustrating the production of monofilaments according to the invention.

Fig. 2 is a schematic view showing one way of flagging bristles according to the present invention.

Fig. 3 is a flagged bristle according to the invention.

Fig. 4 is a sectional view of a brush according to the invention.

Referring to Fig. 1, monofilaments according to the invention may be made by heating a mixture of the synthetic resins as defined above in a conventional extrusion apparatus 1 to a temperature between about 200° C. and about 260° C., depending on the particular resinous mixture being handled, and extruding the hot mixture through an orifice 2 into air. The extruded material hardens on being cooled and the resulting filament is taken up on a series of rolls 2–8. Roll 3 is unheated, but the subsequent rolls 4–8 are heated by means of steam introduced through line 9. The rolls are maintained at a temperature between about 120° C. and about 160° C., depending on the composition of the fiber, so that when the filament has reached roll 8 it is at a temperature in that range. From roll 8 the softened filament is passed to a drawing roller 10 and in passage is stretched from three to five times its spun length. The stretched filament is then wound on a reel 11.

It will be understood that although for purposes of illustration spinning in air has been shown, extrusion in other mediums is also possible and entirely within the scope of the invention.

The filaments obtained on reel 11 may be cut into lengths and made up into brushes by any suitable process (not shown). If desired, they may be flagged before assembly into brushes. However, it is preferable to make up the brushes first and then flag them since flagged bristles are more difficult to handle in the brush making.
process. As pointed out above, it is one of the outstanding advantages of the present invention that bristles made according to it can be flagged in the brush. A brush containing the novel flagged bristles is shown in Fig. 4. It may be of conventional construction comprising a handle 40 joined to a block 41 by a ferrule 42. Bristles 45 are held bunched together and are also held in the block 41 by means of any conventional adhesive as at 47. Nails 43 secure the ferrule 42 to the block 41 and also help to hold the bristles in the block. Nails 44 are provided for holding the ferrule to the handle 40.

The flagged portion of the bristles 45 is indicated at 46 in Fig. 4. Usually it will extend about one inch from the end of the brush, although it may be made to extend further, if desired.

It will be understood that the brush construction shown in Fig. 4 is shown for illustration only. Obviously the novel bristles may be used equally as well with other types of brushes. If desired, in making a brush, the novel bristles may be blended with bristles of other types.

One way of flagging the bristles of the present invention is shown schematically in Fig. 2. As shown in that figure, the bristles 20 mounted in a brush 21 are held against a blade 22 rotated at about 3600 R. P. M. by a motor 23. Suitable screening 24 may be provided for safety. The impact of blade 23 on the surface of the bristles causes them to split or flag.

A bristle so flagged is shown in Fig. 3. As shown in that figure, each bristle 30 is split into several sub-filaments 31, which in turn are split into even finer filaments 32, and even these finer filaments may themselves be split. The result is that each bristle has at its tip a mass of hair-like fibrils, which give a brush assembled from such bristles extraordinary paint retaining qualities and the ability to form an exceptionally smooth coating.

While it is not known exactly why filaments made in the manner described flag so readily, it is theorized that since the resinous components are essentially non-compatible, the monofilaments as formed are made up of a series of microscopic or submicroscopic longitudinal elements, each chemically homogeneous, but surrounded by other similar elements of different composition. Under impact, a split occurs along the boundary between one segment and a neighboring segment of different composition. This analysis is supported by the observation that maximum flaggability is found in 50-50 mixtures and decreases as the preponderance of any one component increases.

The invention will be further described by the following specific examples, in which the parts are by weight, it being understood that the examples are given for purposes of illustration only and are not intended to restrict the invention beyond the scope of the appended claims.

**Example I**

A molten mixture of 92 parts of a copolymer of 27% acrylonitrile and 73% styrene having a molecular weight of about 64,000 with 8 parts of nylon 10001 (polyhexa-methylene adipamide) was prepared. The mixture at a temperature of about 280° C. was extruded in air to form a group of parallel filaments. The filaments were then brought to a temperature of about 120° C. and stretched to four times their extruded length. After cooling they were flagged by cold drawing to rupture.

**Example II**

Example I was repeated but using in place of the copolymer, 8 parts polystyrene. Readily flaggable fibers were obtained.

**Example III**

Example I was repeated but using a mixture of 80 parts nylon 10001 and 20 parts copolymer. An easily flagged bristle was obtained.

**Example IV**

A mixture of 50 parts of a copolymer of 27% acrylonitrile and 73% styrene, having a molecular weight of about 64,000, was mixed with 50 parts of a polystyrene having a molecular weight in the range 45-70,000. The hot mixture was extruded in air at 500° F., to form a group of parallel filaments. The filaments were cooled and then reheated to 148° C. and stretched to four times their original length. They were then cut into 3" lengths, fixed in a brush block and flagged by contact with a blade rotating at 3500 R. P. M. Heavy flagging extending about one inch from the tips of the bristles resulted.

**Example V**

The procedure of Example IV was carried out using a mixture of 5 parts of the copolymer and 95 parts polystyrene. Satisfactory flagging was obtained, although the flagging did not extend as far along the bristles as in Example IV.

**Example VI**

The procedure of Example V was carried out using 5 parts polystyrene and 95 parts of the copolymer. The flagging properties of the resulting bristle were similar to those of Example V.

A consideration of the foregoing description will show that the present invention provides bristles which are readily flagged and are flaggable to a much higher degree than had hitherto been possible. Bristles according to the invention may moreover be flagged while in the brush, minimizing handling problems. Moreover, the present bristles can be made from materials which are much cheaper than the straight polyamides hitherto employed for flagged synthetic brushes.

It is a further important advantage of the new bristles that as a brush in which they are incorporated is worn down, the flagged section moves up the bristles, so that the ends of the bristles are never worn to the extent that they become unflagged. This feature is also characteristic of high grade natural bristles. It is not found in other synthetic bristles.

What is claimed is:

1. A flagged bristle comprising a stratched monofilament consisting essentially of a mixture of at least two synthetic resins selected from the group consisting of polystyrene, copolymers of acrylonitrile and styrene containing between about 20% and about 37.5% by weight acrylonitrile and synthetic linear fiber forming polyamides, one of said resins constituting between about 1% and about 99% of the weight of said bristle.

2. The bristle claimed in claim 1 in which one of said group of resins constitutes between about 5% and about 95% by weight of said bristle.

3. The bristle claimed in claim 1 and consisting essentially of between about 5% and about 95% by weight of polystyrene, and the balance a copolymer of styrene and acrylonitrile containing between about 20% and about 37% by weight acrylonitrile.

4. A brush having flagged bristles, each of at least certain of said bristles consisting essentially of a mixture of at least two resins selected from the group consisting of polystyrene, copolymers of styrene and acrylonitrile containing between about 20% and about 37.5% by weight acrylonitrile and fiber forming linear polyamides, at least one of said resins constituting between about 1% and about 99% by weight of each of said certain bristles.

5. A brush having bristles, each of at least certain of said bristles being characterized in that they can be flagged while in the brush by surface impact and consist-
ing essentially of a mixture of at least two resins selected from the group consisting of polystyrene, copolymers of styrene and acrylonitrile containing between about 20% and about 37.5% by weight acrylonitrile and fiber forming linear polyamides, at least one of said resins constituting between about 1% and about 99% by weight of each of said certain bristles.

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